§14. High W_p Experiment

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The diamagnetic energy (W_p) is the energy confined in the plasma, and it represents overall performance of a plasma confinement device. So far, the record W_p (1.31 MJ) was obtained in the case of R_{ax}=3.6 m. In this case, the plasma volume is large and the neoclassical transport is reduced. This shot (#47919) is referred as R_{ax}=3.6m in Figs. 1-3 in this report. In the 9th campaign, the pipe-gun type and the repetitive H_2 ice pellet injectors have been significantly improved, and the 40 kV, 3 MW NBI for diagnsotics (NBI#4) has been installed.

Figure 1 shows the obtained W_p versus R_{ax}. New record (1.37 MJ) is obtained in the case of R_{ax}=3.65 m. Fig. 2 shows time evolution of n_{e0}, T_{e0} and W_p. In the high W_p experiment, 8 larger ice pellets are injected from the pipe gun with 30 – 50 ms interval, then small ice pellets are injected repetitively. After the large pellet injection, the T_e grows as the n_e is decreased, so that the W_p is increased. This phenomenon is called “reheat”.

In the previous campaigns, the ice pellets are injected in plasma with lower heating power in order to evaporate limited number of pellets should in the core plasma. In this experiment, most NBI is injected during pellet injection since the pellet becomes bigger. Since the pulse length of NBI#4 is limited, NBI#4 is injected in the reheat phase.

Fig. 3 shows the radial profiles of n_e and T_e measured by the Thomson scattering. The value of n_e is normalized by the FIR laser interferometer at t=0.5 sec and the unit may be close to 10^{19} m^{-3}. Although still some systematic error may be remained in the n_e profile, we can observe a peaked n_e profile in the case of R_{ax}=3.75 m. In the smaller R_{ax} cases, the n_e profile is rather flat. Interestingly, in any cases, we can observe a small step in the n_e profile at R=4.25 m, where the iota=1 surface is located.

The plasma confinement should be improved to obtain much higher W_p. The n_e profile control may be a key. The small step in the n_e profile might be a sign of the confinement improvement.

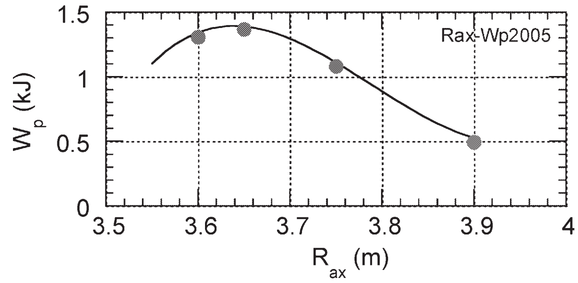

Fig. 1 Obtained W_p vs. the radius of the magnetic axis.

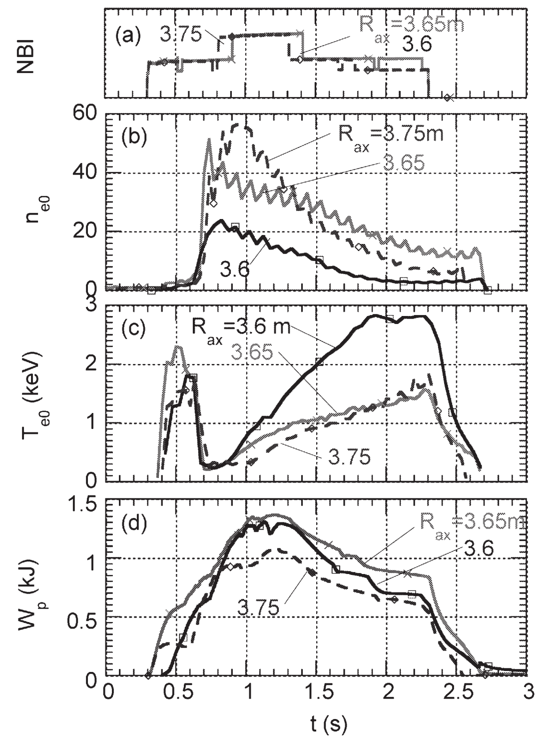

Fig. 2 Time evolution of (a) NBI, (b) T_{e0}, (c) n_{e0}, (d) W_p in high W_p plasmas.

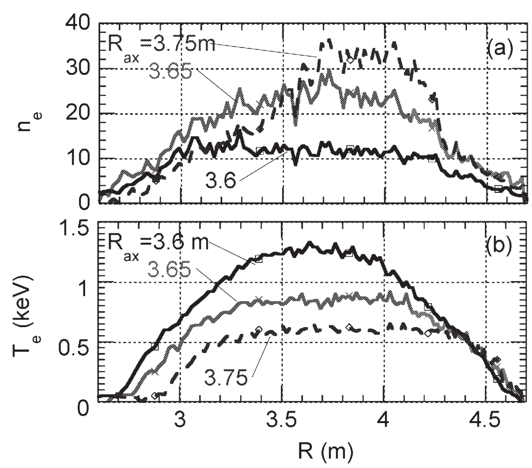

Fig. 3 Radial profile of (a) T_e, (b) n_e in high W_p plasmas.